# ARJUNA

JEE

LECTURE - 09

# Mole Concept

Sarvesh sir

# TABLE OF CONTENT


01 concentration

02 PPB ,PPM

03

04

Q. An aqueous solution of glucose is 10% (w/v). select the correct statements

solution

solute

| | | | |
|---|---|---|---|
| A | *mass of glucose is* 100 *gram* | B | *mass of glucose is* 10 *gram* |
| C | mass of glucose is 90 gram | D | none of these. |

82% B

10gram solute (Glucose)

100ml solution

ARJUNA

**Q.** Density of 20%(w/v) solution of propane is 1.5 g/mL, then calculate mass percentage of propane is solution.

20 gram propane

100 ml solution

| | | | |
|---|---|---|---|
| A | $\frac{20}{3}$ | B | 20 |
| C | 40 | D | $\frac{40}{3}$ |

$M = v \times d$

Mass of sol$^{n}$ $= 1.5\frac{g}{ml} \times 100$ ml

$= 150$ gram

Mass % of propane $= \frac{W_{propane}}{W_{sol^{n}}} \times 100$

$= \frac{20}{150} \times 100$

$\frac{200}{15} = \frac{40}{3}$

ARJUNA

# PART PER MILLION (PPM)

**Total amount of solute dissolved in $10^6$ gram or 1 million gram of solution**

$$P.P.M = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^6$$

$$P.P.M = \frac{\text{Mass of solute}}{\text{Mass of sol}^n} \times 10^2 \times 10^4$$

$$P.P.M = \text{Mass \%} \times 10^4$$

# PART PER BILLION (PPB)

**Total amount of solute dissolved in $10^9$ gram or 1 billion gram of solution**

$$P.P.B. = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 10^9$$

$$= \frac{\text{Mass of solute}}{\text{Mass of sol}^n.} \times 10^2 \times 10^7 = \frac{\text{Mass of solute}}{\text{Mass of sol}^n.} \times 10^6 \times 10^3$$

$$\rightarrow P.P.B = \text{mass}\,\% \times 10^7$$

$$\rightarrow P.P.B = P.P.M \times 10^3$$

$C_{SD} = 27$

(1) 100 gram sol$^{n}$ = Mass of solute $\Rightarrow$ Mass %.

$10^{6}$ gram sol$^{n}$ = Mass of solute $\Rightarrow$ P.P.M.

$10^{9}$ gram sol$^{n}$ = Mass of solute $\Rightarrow$ P.P.B.

(2) $\boxed{\text{P.P.B.} = \text{P.P.M} \times 10^{3}}$

$\text{P.P.B.} = \text{Mass \%} \times 10^{7}$

$\text{P.P.M.} = \text{Mass \%} \times 10^{4}$

(3) Mass %, P.P.M & P.P.B. are unitless quantity

Q. Select the correct relation between mass % of solute and ppm of solute.

A $\text{ppm} = \text{mass \%} \times 10^6$

B $\text{ppm} = \text{mass \%} \times 10^9$

C $\text{ppm} = \text{mass \%} \times 10^2$

D $\text{ppm} = \text{mass \%} \times 10^4$

Q 5 gram NaOH present in 10 gram solution.

(A) Mass % of NaOH = 50% = $\frac{5}{10} \times 100 = 50\%$

(B) P.P.M of NaOH = $50 \times 10^4$

(C) P.P.B. of NaOH = $50 \times 10^7$

**Q.** Calculate the parts per million of $SO_2$ gas in 250ml water (density = 1 g $cm^{-3}$) containing $5 \times 10^{-4}$ g of $SO_2$ gas.

$(Mass)_{H_2O} = 250 \times 1 = 250$ gram

| | | | |
|---|---|---|---|
| A | 1 | B ✓ | 2 |
| C | 10 | D | 20 |

$$\text{Sol}^n - \text{P.P.M} = \frac{\text{Mass of solute}(SO_2)}{\text{Mass of sol}^n.} \times 10^6$$

$$= \frac{5 \times 10^{-4}}{(250 + 5 \times 10^{-4})} \times 10^6 = \frac{500}{250} = 2$$

$$\begin{array}{r} 250.0000 \\ .0005 \\ \hline 250.0005 \end{array}$$

ARJUNA

**Q.** A sample of drinking water was found to be severely contaminated with chloroform ($CHCl_3$) supposed to be a carcinogen. The level of contamination was 15 ppm (by mass):]

(i) express this in percent by mass

(iii) express this in P.P.B

Sol$^{n}$ → (i)

$$P.P.M = Mass\,\% \times 10^4$$

$$15 = Mass\,\% \times 10^4$$

$$Mass\,\% = 15 \times 10^{-4}$$

(ii)

$$P.P.B. = PPM \times 10^3$$

$$= 15 \times 10^3$$

ARJUNA

**Q.** How much $Ca(NO_3)_2$, in mg, must be present in 50ml(d = 1 g/mL) of a solution with 2.35ppm of Ca?

$M = v \times d =$ $50 \times 1 = 50$ gram of solution

| | | | |
|---|---|---|---|
| A | 0.1175 | B | 770.8 |
| C | 4.7 | D | 0.48 |

Mole of Ca = 1 × mole of $Ca(NO_3)_2$

Ca = 40
2N = 28
6O = 96
164

$$PPM = \frac{\text{mass of Ca}}{\text{mass of sol}^n} \times 10^6$$

$$2.35 = \frac{\text{mass of Ca}}{50} \times 10^6$$

Mass of Ca = $2.35 \times 50 \times 10^{-6}$
$= 117.5 \times 10^{-6}$

Mole of Ca = $\frac{117.5 \times 10^{-6}}{40}$
$= 2.93 \times 10^{-6}$ mole

Mole of $Ca(NO_3)_2 = 2.93 \times 10^{-6}$ mole

Mass of $Ca(NO_3)_2 = 2.93 \times 10^{-6} \times 164$ gram
$= 481.75 \times 10^{-6}$ gram

$481.75 \times 10^{-6}$ gram

$481.75 \times 10^{-6} \times 10^{3}$ mg

$481.75 \times 10^{-3}$ mg

$0.48175$ mg

Q 4 gram NaOH present 50 gram of solution
Select the correct option

$\frac{4}{50} \times 100 = 8$

✗ (a) Mass % of NaOH is 40%.

✗ (b) P.P.M. of NaOH is $40 \times 10^3$ $\Rightarrow$ $\frac{4}{50} \times 10^6 = \frac{4}{5} \times 10^5 = 8 \times 10^4$

✗ (c) P.P.B. of NaOH is $4 \times 10^9$ $= \frac{4}{50} \times 10^9 = 4 \times 2 \times 10^8 = 8 \times 10^8$

✓ (d) None of these

## $C_{SD} = 28$

① $x$ % (w/w) solution-1 + mix with $y$ % (w/w) of solution-2, Calculate mass % of final sol$^{n}$ =

Mass % of final sol$^{n}$ = $\left(\frac{x+y}{2}\right)$ %

Note → yadi dono solution ke mass different ho, to solve krte hai basic method se

Q. 20% (w/w) solution of NaOH mix with 10% (w/w) solution of NaOH. Calculate mass percentage of NaOH in resultant solution

20 gram NaOH | 100 gram Na

(A) 15%

(B) 20%

(C) 30.%

(D) 35%

20% | 20g NaOH | 100 gram soln.

10% | 10 gram NaOH | 100 gram soln.

Resultant = 20+10 = 30 gram NaOH = 200 gram soln

Soln → M-1 ⇒ $\frac{20+10}{2} = 15\%$

M-2

Mass % of NaOH in resultant soln. $= \frac{W_{NaOH}}{W_{soln.}} \times 100$

$= \frac{20+10}{200} \times 100 = \frac{30}{200} \times 100 = 15\%$

ARJUNA

Q 30 %. (w|w) sol$^{n}$. of glucose mix with 20 %. (w|w) sol$^{n}$. of glucose. Calculate mass %. of glucose in resultant solution

(a) 30 %.

(b) 35 %.

(c) 25 %.

(d) 45 %.

**Q.** 300gram solution of 20% (w/w) NaOH mixed with 200 gram solution of 10% (w/w) NaOH solution , calculate mass percentage of NaOH in resultant solution

A 16%

B 32%

C 10.%

D 12%

Mass % of NaOH in resultant sol$^{n}$ $= \frac{80}{500} \times 100$

$= \frac{80}{5}$

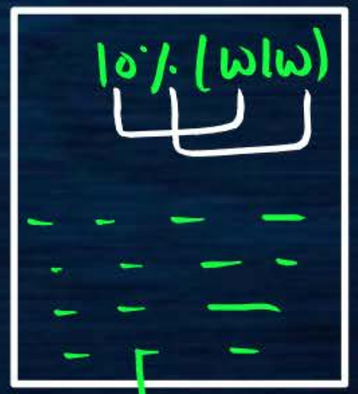
$= 16\%$

Sol$^{n}$.

300gram sol$^{n}$.

60gram NaOH

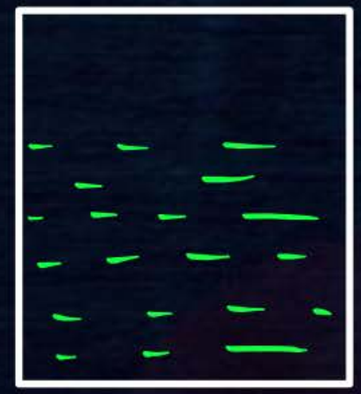
+




200gram solution

20gram NaOH

$\Rightarrow$



200+300 = 500gram

60+20 = 80gram

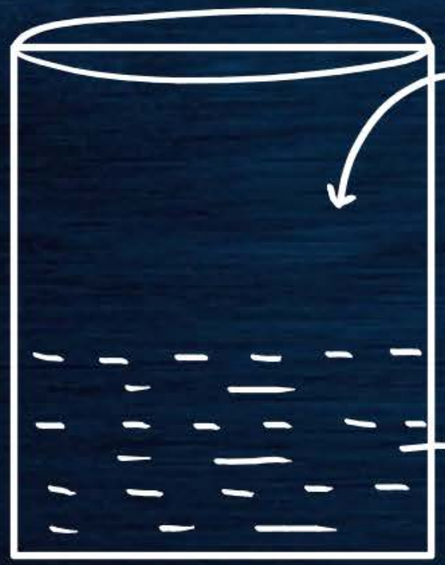
ARJUNA

$$20\% = \frac{W_{NaOH}}{W_{Sol^n.}} \times 100$$

$$20\% = \frac{W_{NaOH}}{300} \times 100$$

$$W_{NaOH} = 60 \text{ gram}$$

# Mole fraction



$n_1$ solute

$n_2$ mole solvent

total mole of solution $= n_1 + n_2$

→ Mole fraction of solute $= \frac{n_1}{n_1+n_2}$

$(X_1)$

↓

Chai

$= \frac{\text{Mole of solute}}{\text{mole of soln}}$

→ Mole fraction of solvent $= \frac{n_2}{n_1+n_2}$

$(X_2)$

$= \frac{\text{mole of solvent}}{\text{mole of solution}}$

ARJUNA

Q 4 gram NaOH dissolved in 18 gram of water
Calculate mole fraction of NaOH in soln.

(a) 0.2

(b) 0.35

(c) 0.79

✓ (d) None of these

$\eta_{NaOH} = \frac{4}{40} = 0.1$

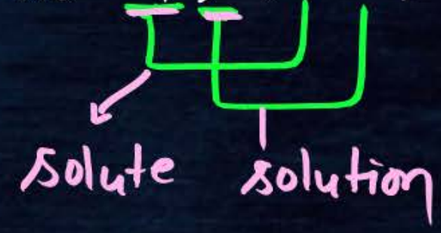
$\eta_{H_2O} = \frac{18}{18} = 1$

mole fraction of NaOH $= \frac{\eta_{NaOH}}{\eta_{NaOH} + \eta_{H_2O}} = \frac{0.1}{1+0.1} = \frac{0.1}{1.1}$

$= \frac{1}{11}$

Q Mass % of NaOH in aqueous solution of NaOH is 4% (w/w)

Calculate mole fraction of NaOH.




(a) 0.6

(b) 0.8

(c) 0.45

(d) None of these

Sol$^{n}$ → Mole fraction NaOH = $\frac{\eta_{NaOH}}{\eta_{NaOH}+\eta_{H_2O}} = \frac{0.1}{5.34+0.1} = 0.0184$

$\eta_{NaOH} = \frac{4}{40} = 0.1$

$\eta_{H_2O} = \frac{96}{18} = 5.34$

Mass of sol$^{n}$ = 100 gram

Mass of solute (NaOH) = 4g

Mass of solvent ($H_2O$) = 100 − 4 = 96 gram

# Home work

pw module

EXERCISE NO.-01

question no . 3,5,6,7,8,9,10,12,13,14,15,16,17,18,19,20,21,
22,23,24,

# Thank - You